Upscaling near-bottom sediment-turbulence interaction effects for large-scale 3D sediment transport modelling

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Currently used 3D sediment transport models still fail to make good quantitative predictions. Several causes can be attributed to the inadequate description of physical processes which occur at the subgrid scale level. Specific attention is given to the modelling of turbulent mixing, particle-turbulence interactions and near-bottom boundary layer processes. Due to these processes the effective bottom roughness is modified, resulting in different flux balances. These important effects are not yet incorporated into current hydrodynamic calculations and can explain discrepancies in predicted flow fields. A procedure for the development of new subgrid scale closures for the simulation of sediment-laden turbulent flow with engineering models applied to problems at geophysical scales of coastal waters and estuaries is described It is based on two-phase flow theory and data generated by Large Eddy Simulation and low-Reynolds RANS models. This leads to a three-layer approach, comprising a supersaturated near-bed layer, a transition layer (under certain conditions) and the fully developed turbulent water column.

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